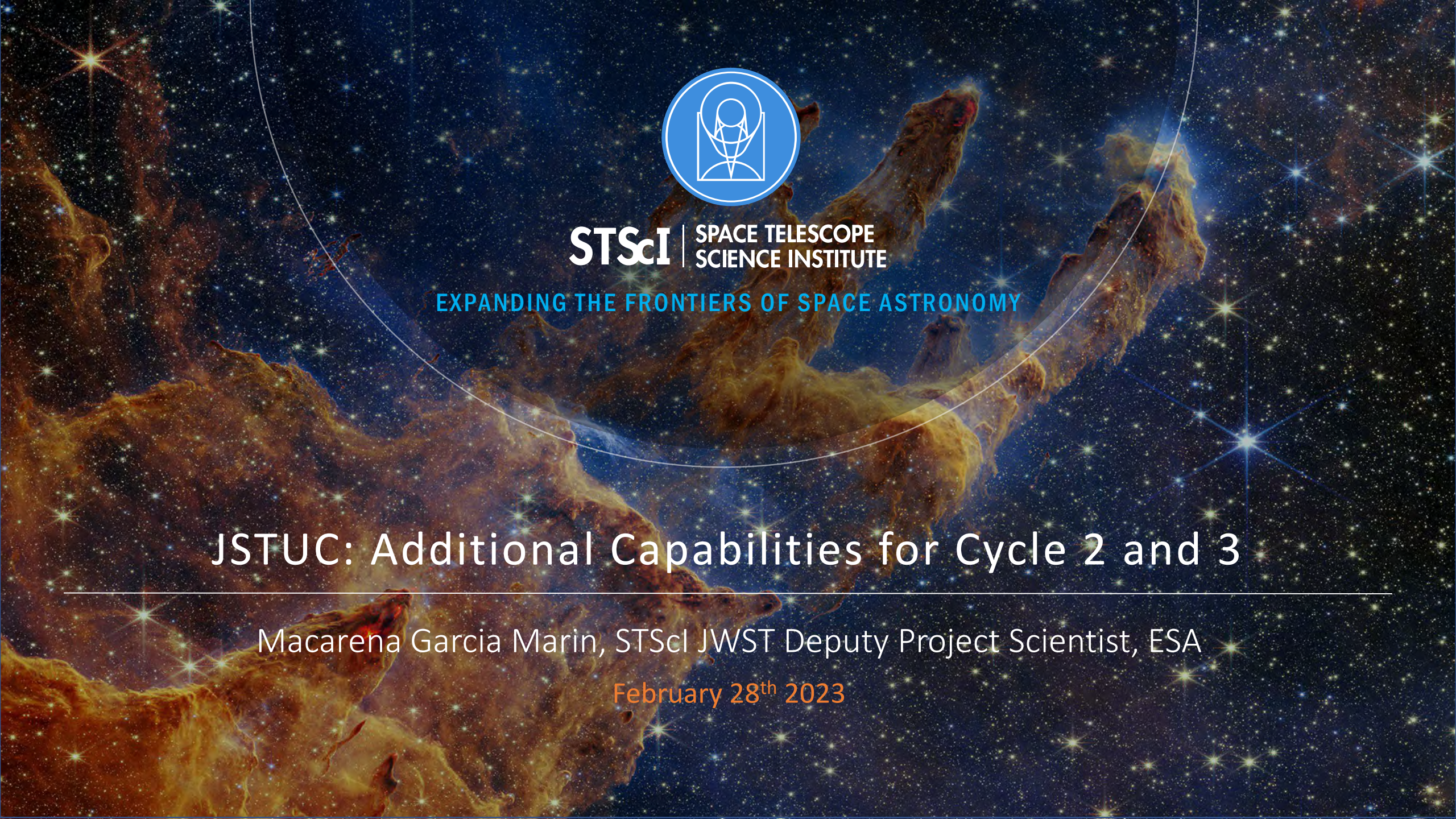


JSTUC: Additional Capabilities for Cycle 2 and 3

Macarena Garcia Marin, STScI JWST Deputy Project Scientist, ESA

February 28th 2023

Type of enhancements

- All SOC subsystems work on fixes and enhancements.
- When those affect more than one subsystem (e.g. PPS, PRD and OSS) the request is made via a JSOCINT ticket. These tickets include the following categories:
  - Improve observatory efficiency
  - Anomalies management
  - Improve data quality
  - Improve user tools
  - Add new science capability
  - Enhance S&OC operations
  - Mission lifetime
- The SPWG (Science Planning Working Group), that includes representatives from all stakeholders, prioritizes the list based on:
  - Health and safety
  - Balance between science outcome and implementation difficulty
  - Efficiency impact
- Resource availability will alter actual implementation order

Current and upcoming enhancements

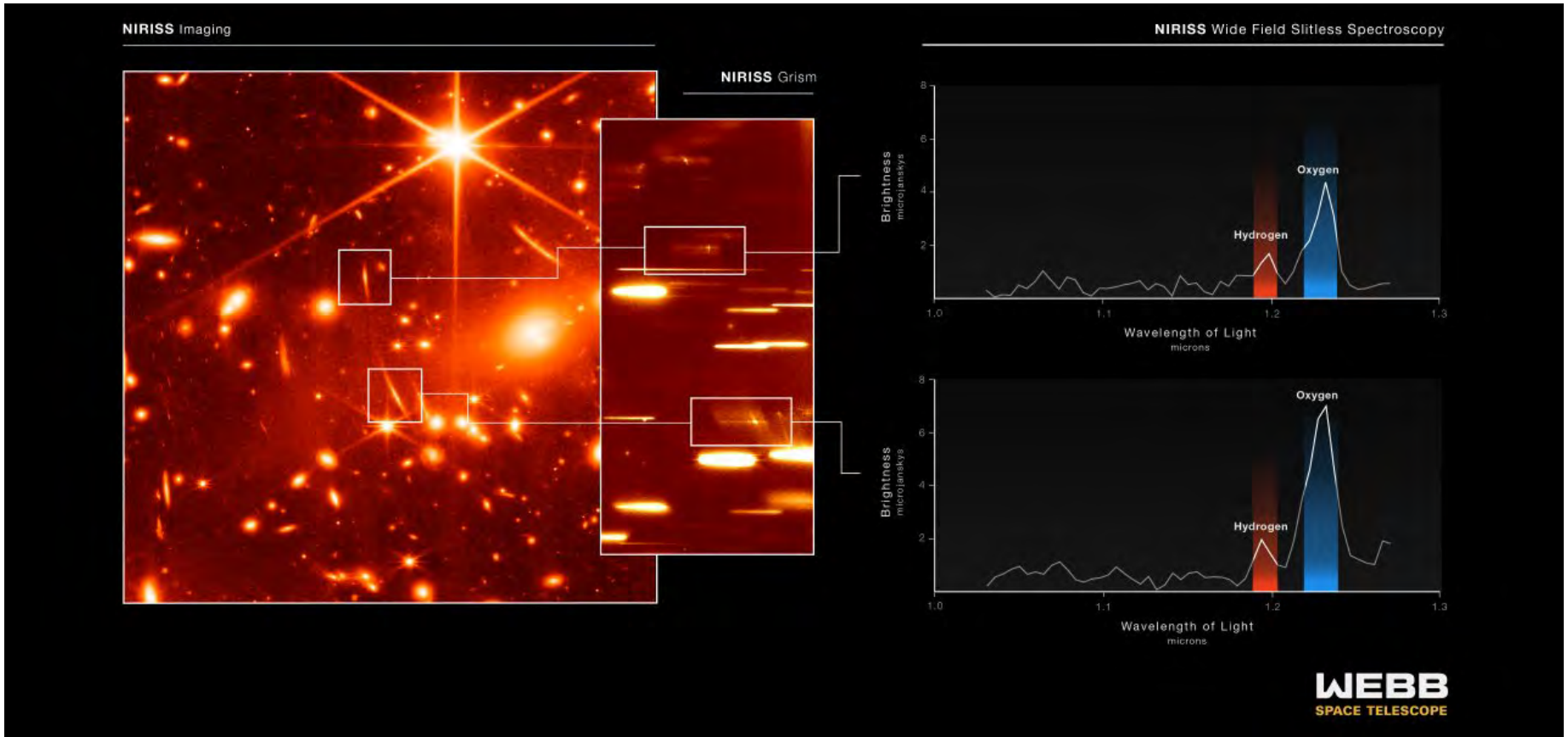
- In what follows we will talk about:
  - Available Cycle 2 enhancements
  - Enhancements in development for Cycle 3
  - **Cycle 3 approved enhancements (approved by the SPWG)**
  - **Future enhancements**

- Please provide feedback on which of the **Cycle 3 approved and future enhancements** you consider particularly important.

Available Cycle 2 Enhancements

JSOCINT-705: NIRISS imaging as prime

- NIRISS is very sensitive to low surface brightness features between 0.8–2.5 µm (pixel scale about twice as large as NIRCam's)
- In WFSS, this opens the ability to take additional imaging exposures in filters not used for the grism exposures



Available Cycle 2 Enhancements

JSOCINT-718: Allow multiple exposure specifications (i.e. multiple filter setup) in pure parallel from single SI to be attached to prime visits with multiple exposure specifications.

Cycle 1 approved pure parallels:

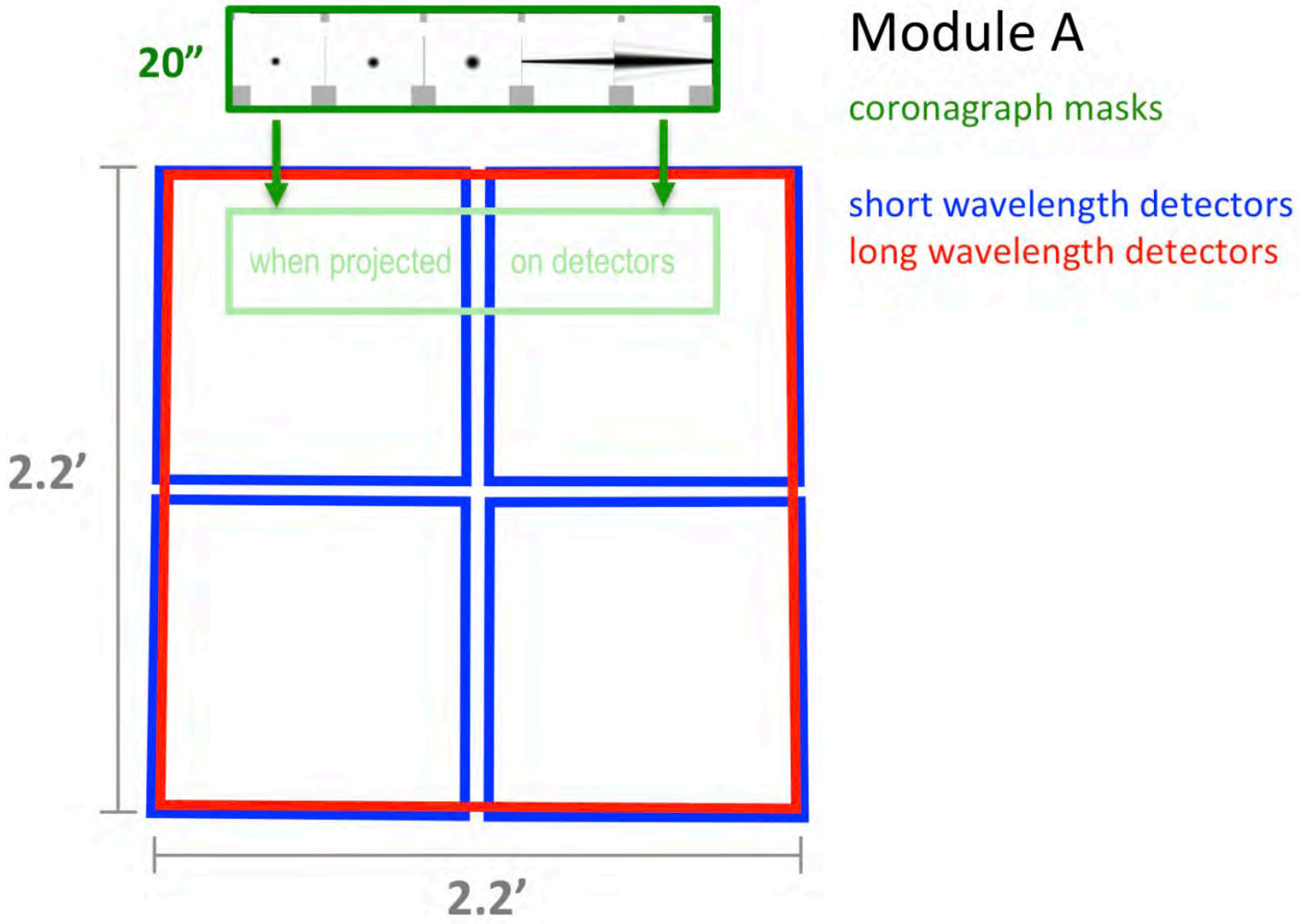
- PID 1571 NIRISS/WFSS 591 hours
- PID 2514 NIRCam/Imaging 150 hours
- PID 2211 NIRCam/Imaging 38 hours

Implementing this change has been critical to the successful execution of Cycle 1 NIRISS WFSS pure parallel observations.

Available Cycle 2 Enhancements

JSOCINT-143: Using NIRCam SW+LW simultaneously in coronagraphy.

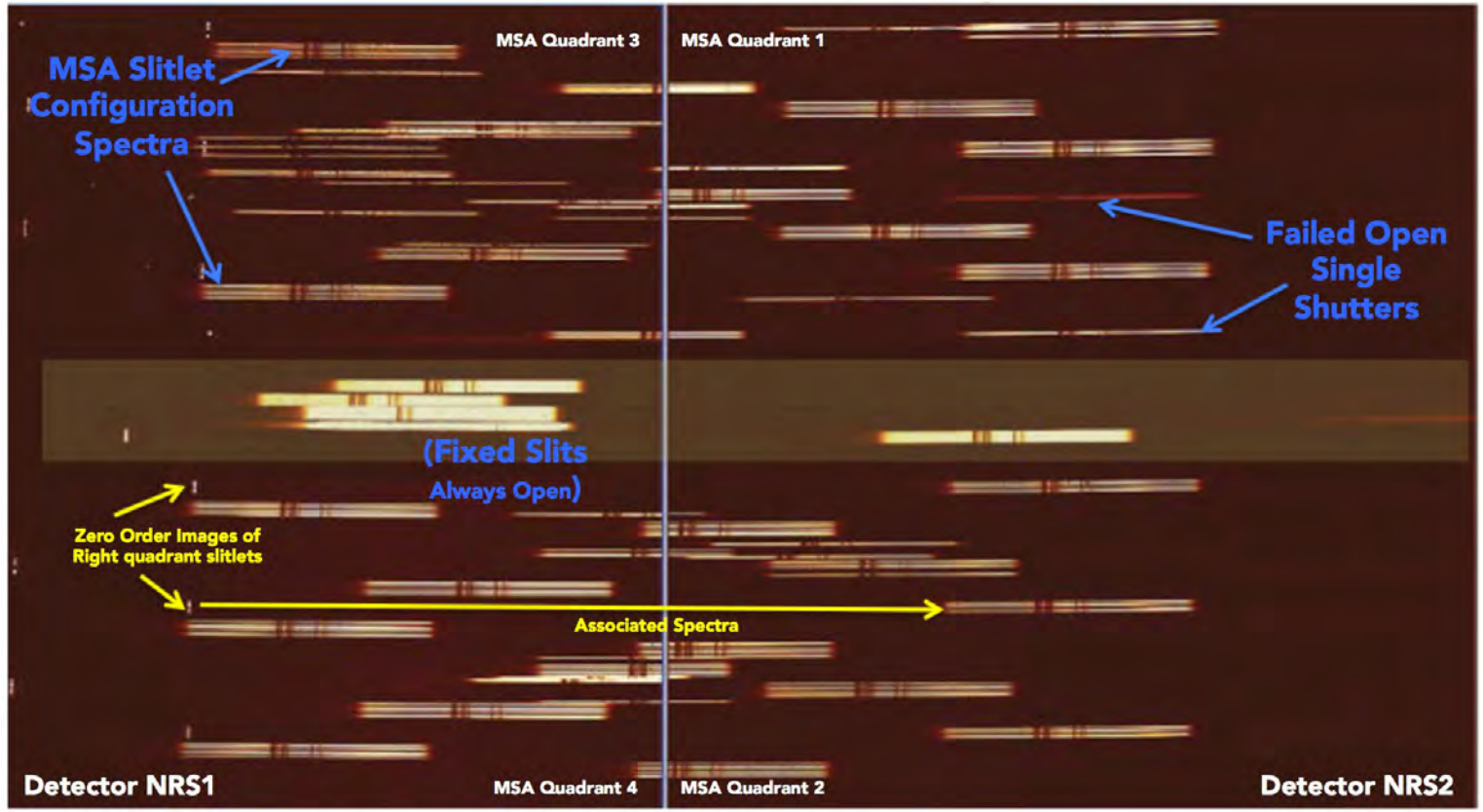
- Collecting images in the non-prime channel
- 6 new subarrays defined
- Increased science return
- Offered for the Cycle 2 CfP



Cycle 3 Enhancements in development

JSOCINT-618: Enable Fixed Slit target in MOS mode

- FSS (fixed slit) apertures are always open, and spectra are imaged onto a detector area that does not impact MOS spectra
- Increasing science return/multiplexing capability. Use case: Primary target in the FS, run the MSA planning tool to optimize planning for additional sources

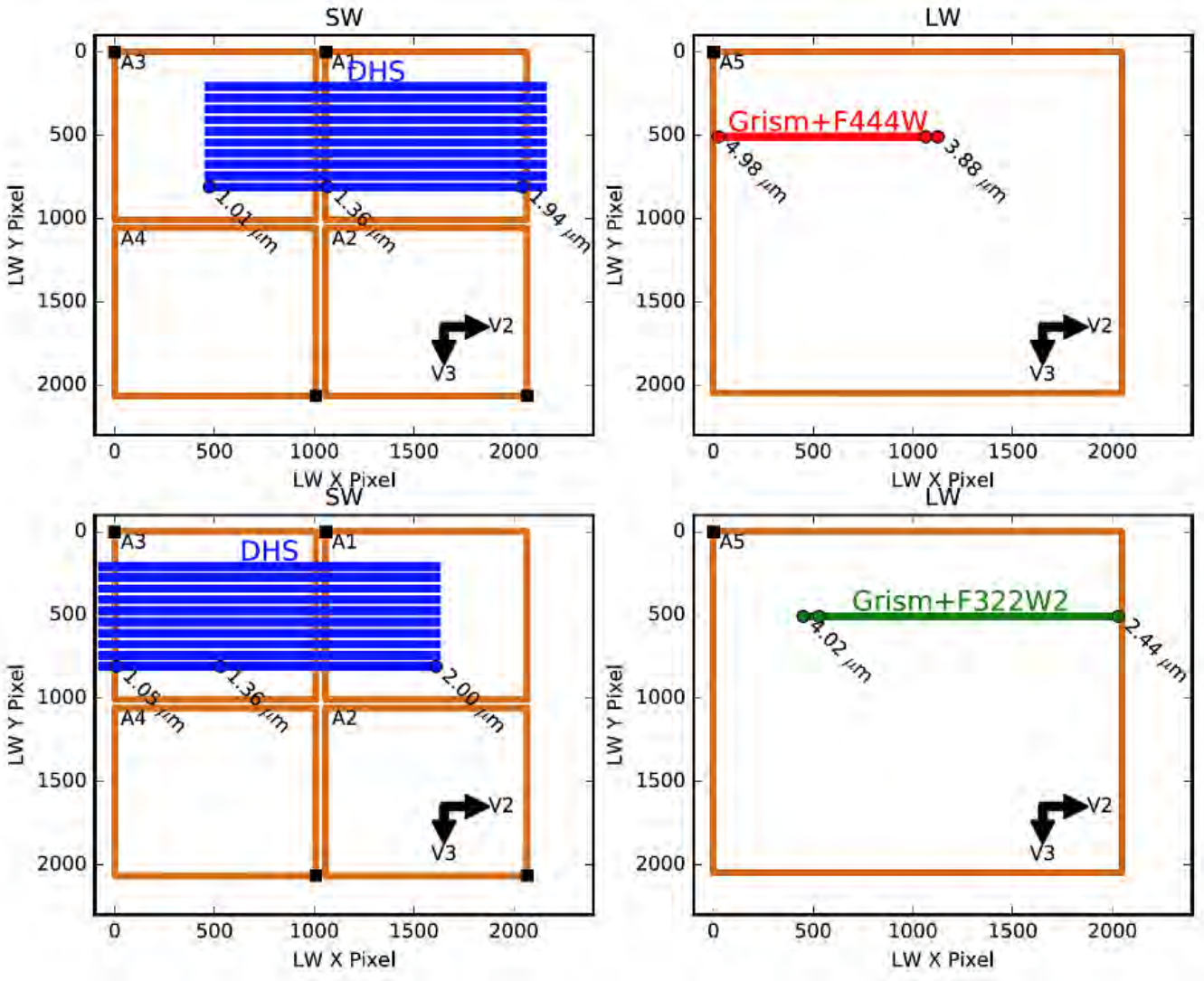


Credit: JDox

Cycle 3 Approved Enhancements

JSOCINT-264: Enable Dispersed Hartman Sensor (DHS) use in NIRCam Grism Time Series template

- Adding simultaneous short wavelength spectra taken using the DHS:
  - 1.01µm to 1.98 µm spectra could be taken at the same time as the standard, longer wavelength, F322W2 or F444W spectra on the long wavelength detectors
  - Enable more precise and accurate determinations of molecular abundances in exoplanet atmospheres (no net increase in observing time)
  - Uses the ASIC substripe mode, an already approved enhancement (JSOCINT-733). It entails reading a small stripe around each spectrum, and then jump by ~ 100 pixels to the next one

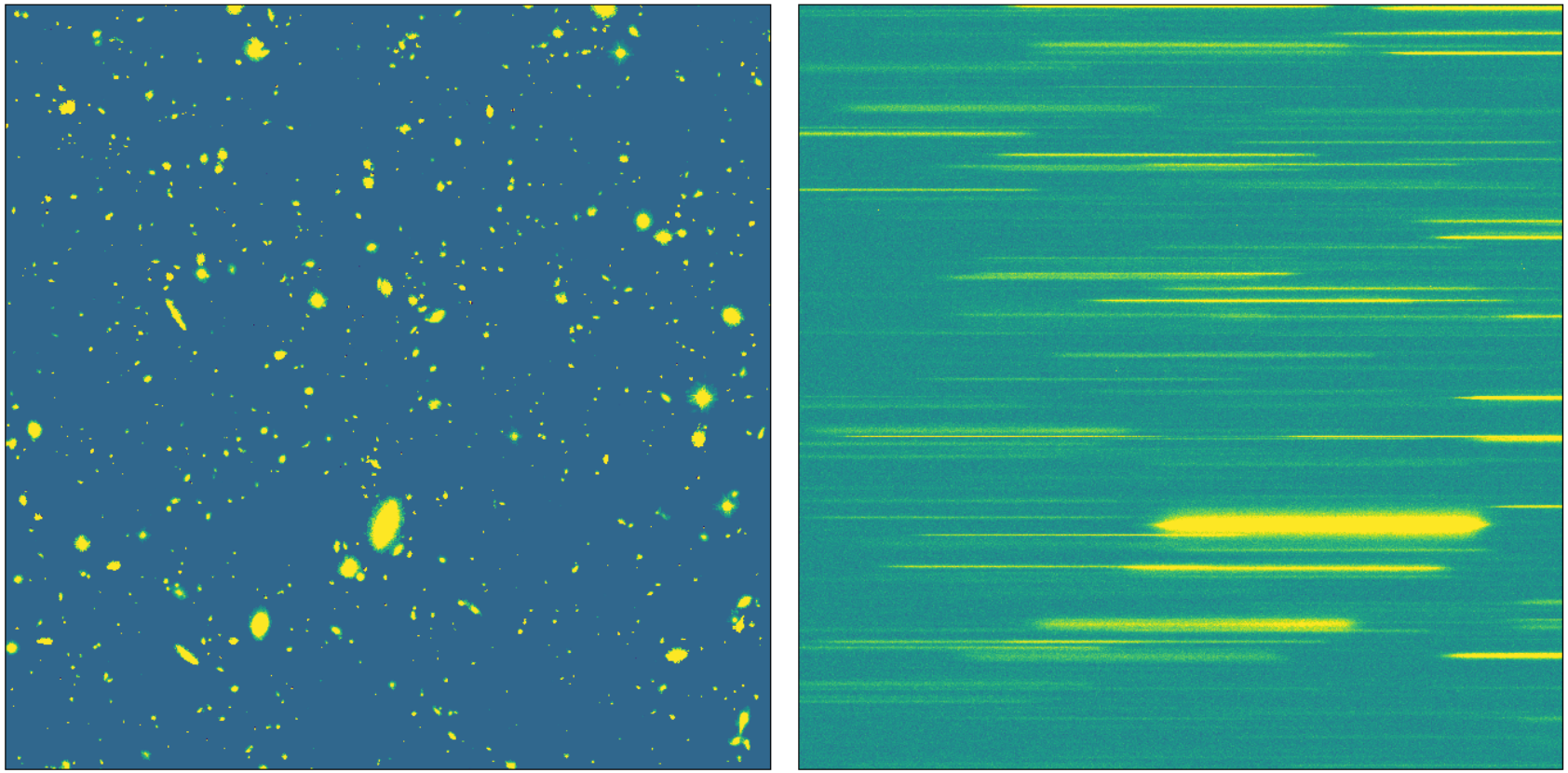


Credit: JDox

Cycle 3 Approved Enhancements

JSOCINT-721: Allow NIRCam Wide Field Slitless spectroscopy pure parallels

- LW direct imaging should always be acquired prior to WFSS (and in the same prime visit)
- Opening the scientific discovery space by allowing surveys of a large number of targets with resolving power ~ 1600 at 4 μm



Simulated single module NIRCam observations. Credit: JDox

Cycle 3 Approved Enhancements

JSOCINT-282: Enable moving target "shadow" observations

- Observe a moving target; when the target has moved out of the FOV come back to do the same observation again, following the same track across the sky, at the same tracking rate
- Allows a precise one-to-one subtraction of the “shadow” observation from the science observation to remove all background sources
- Especially useful for observations of extended but transparent targets

Hale-Bopp comet. IMAGE: Erich Kolmhofer (Johannes-Kepler Observatory), Herbert Raab (Johannes-Kepler Observatory)

Cycle 3 Approved Enhancements

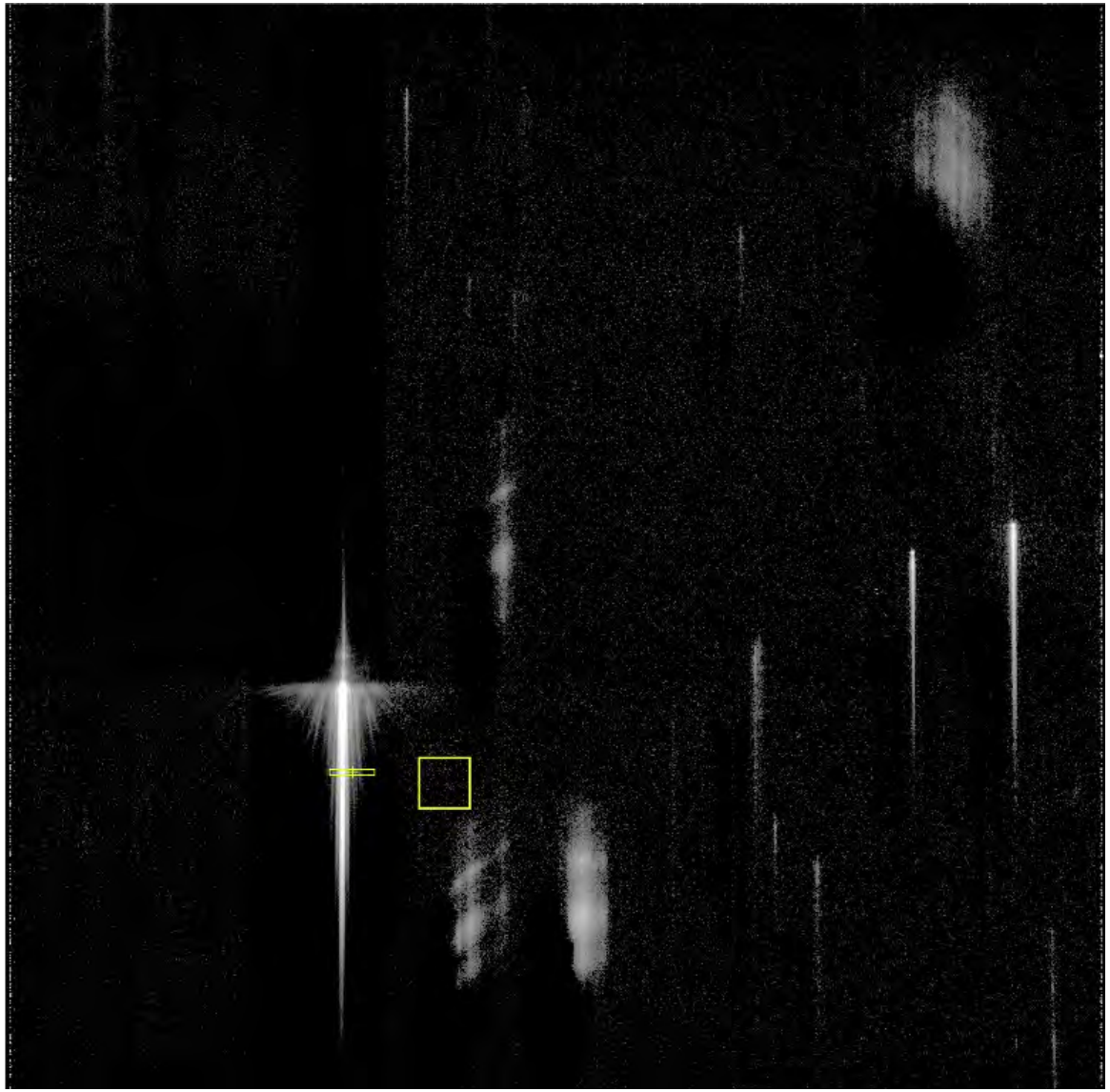
JSOCINT-9: Add flexible mosaic capability to PPS that allows mosaics to execute at multiple orients

- The observer would specify a few high-level parameters: e.g. region of interest, any avoidance regions, and the minimum number of tiles
- The actual tile configuration will be determined automatically, varying as a function of PA
- As the PA changes, the tile positions will be adjusted in a way that optimizes coverage of the region of interest
- This is an enhancement that would facilitate and optimize scheduling

Future enhancements

MIRI LRS WFSS

- All sources in the imager FOV are dispersed when the double prism is in place
- Some operational considerations would have to be evaluated (e.g. need for pre-imaging, observations at different PA)
- Unique ability to obtain simultaneous MIR spectra of multiple targets with a spectral resolving power of about 100 in the range ~5-14 microns

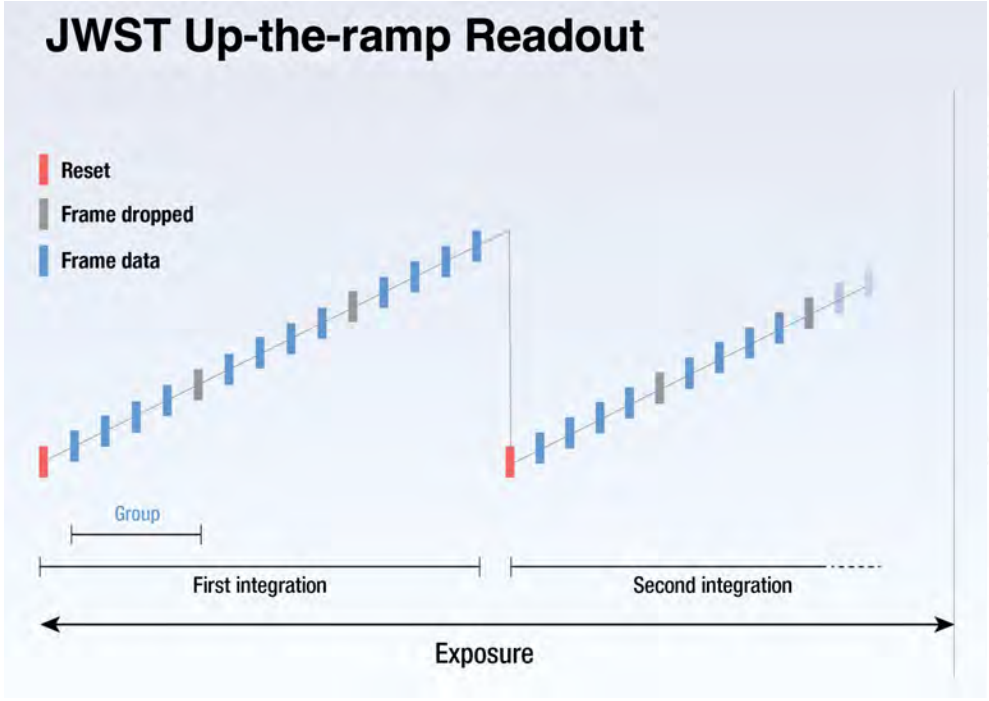


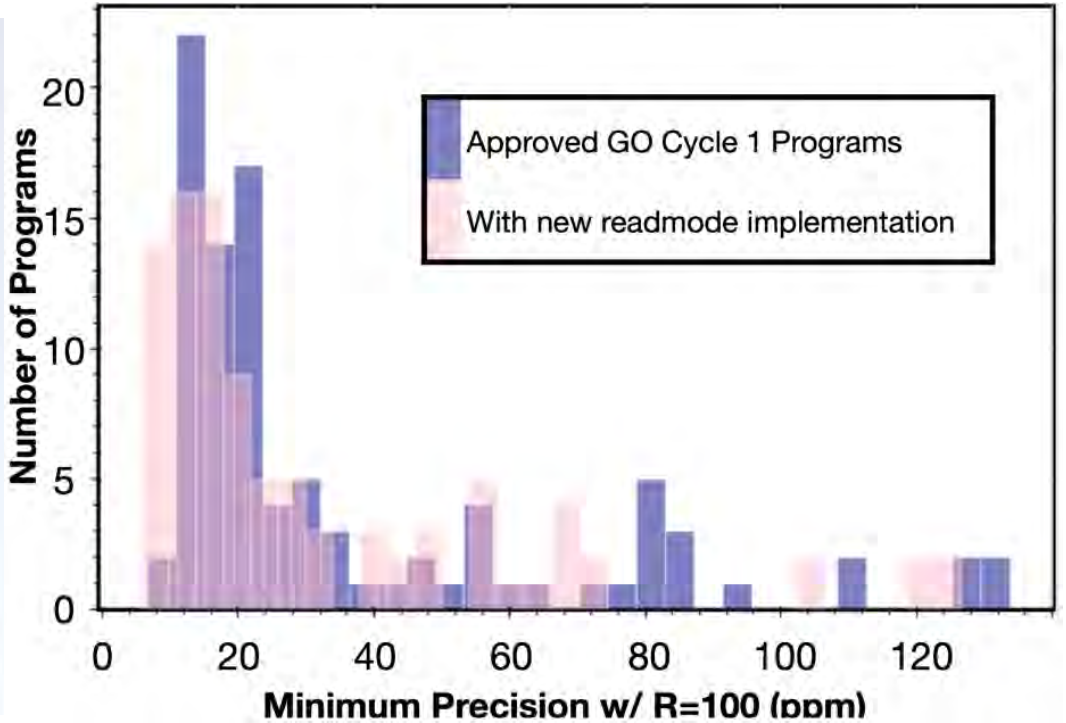
MIRI Commissioning image. Wright et al. 2023

Future enhancements

High efficiency TSO mode

- Achieving 100% detector duty cycle by removing the reset in between integrations
- Improvement in observatory efficiency
- Better precision for TSO science; less efficient programs (i.e. short integrations) benefit the most





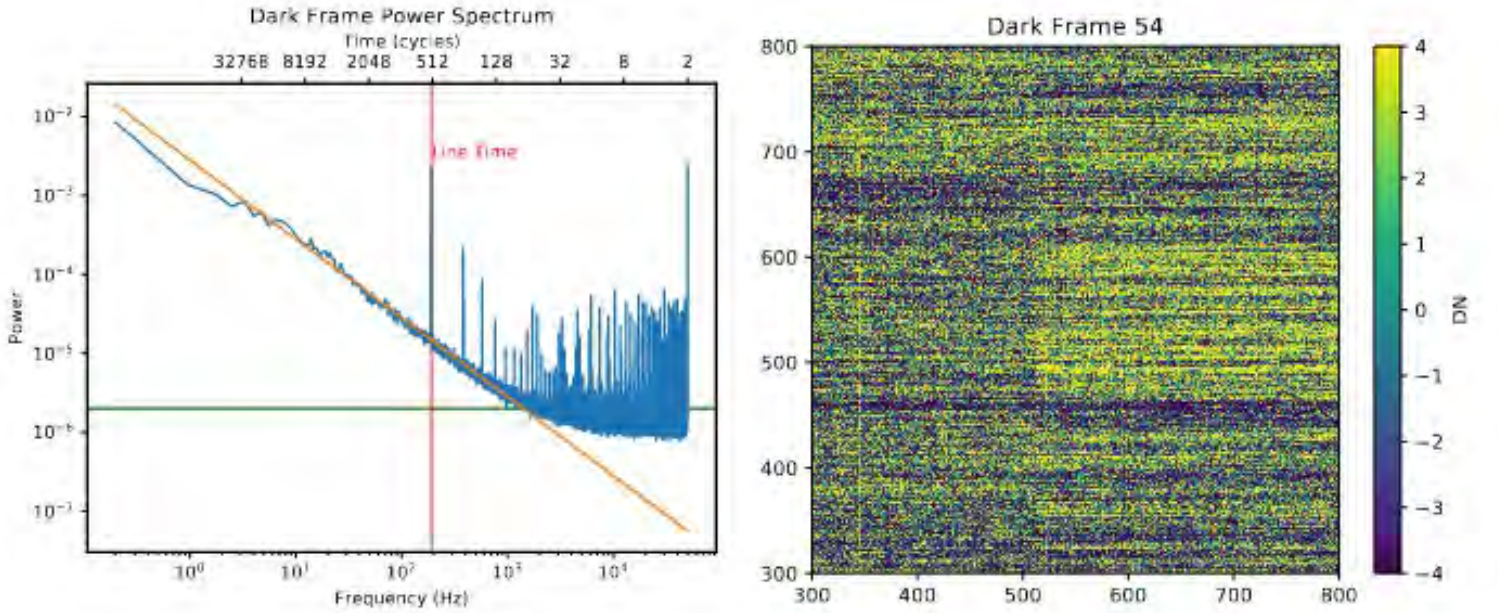
Espinoza et al. JWST-STScI-008104

Future enhancements

JSOCINT-456 Enable use of GRISMC for NIRCam Grism Time Series

- Detector signature injected by the SIDECAR ASIC. Current algorithms/classic background techniques for reducing GRISMR datasets are not effective removing the 1/f noise (noise goes in the same direction as the wavelength direction)
- Latest algorithms leave a 1/f noise floor above the photon noise of 10-30% at least for the bright targets observed so far (photon-noise dominated)
- For NIRCam Grism Time Series, enabling the use of GRISMC (dispersion along columns), would substantially reduce the impact of 1/f noise, and likely lower the TSO noise precision level
- This is, however, retaining the option of using GRISMR with 4 amplifiers, which enables observation of brighter targets without saturation

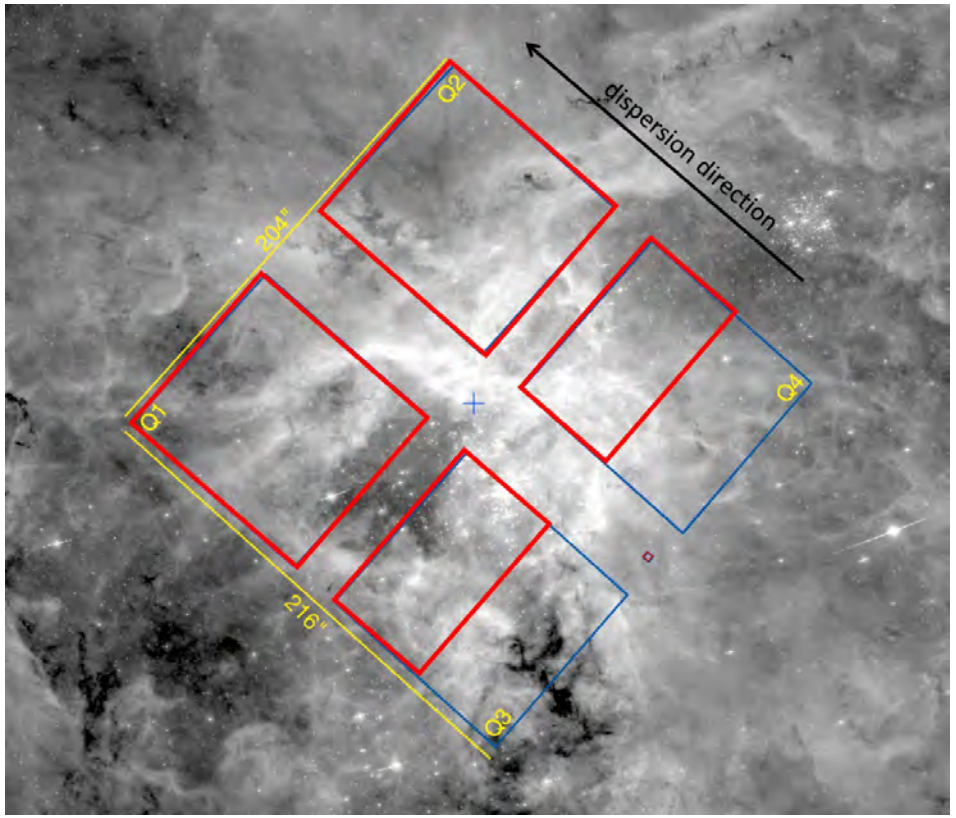
Schlawin et al. 2020. NIRCam ground data



Future enhancements

JSOCINT-201: Enable simultaneous observations with IFU and MSA

- It is possible to observe with the IFU and a portion of the MSA simultaneously when using the prism as a dispersive element, as the IFU spectra do not span the full detector space
- The primary target could be observed with the IFU, while the MSA is used to target other sources in the field



Kassin et al. STScI tech note

Future enhancements

Ultradeep white light FGS imaging

- Unfiltered passband from ~0.6 to 5.0 µm
- Each FPA is a 2048 × 2048 HgCdTe sensor chip assembly that has a 2.3’ × 2.3’ FOV after correcting for internal field distortions
- The FGS has neither a shutter nor a filter wheel; therefore, its detectors are always exposed to the sky